

SEAL FOR A TORSIONAL VIBRATION DAMPER

BACKGROUND OF THE INVENTION

The invention concerns a torsional vibration damper with two components that rotate in relation to each other, and a spring chamber. In this spring chamber is usually at least one spring that acts tangentially between the two components, e.g. a spiral spring.

In the following, axial means a direction parallel to the main rotational axis of the torsional vibration damper, radial means a direction away from the main rotational axis in a plane perpendicular to the main rotational axis of the torsional vibration damper, and tangential means perpendicular to the two cited directions.

SUMMARY OF THE INVENTION

The problem of this invention is to present a generic torsional vibration damper where the spring chamber is sealed against the exit of lubricant, etc. such as grease.

As a solution, the invention suggests a generic torsional vibration damper where the first module has a first guide surface and seals the spring chamber radially outward, whereby the first guide surface is at a distance from the second module across a gap and is essentially radial, and an essentially radial second guide surface is provided that covers the gap (31) on the spring chamber side.

1 The invention is based on the idea that grease flows everywhere in the
2 spring chamber, and when it contacts a wall, it experiences a centrifugal force
3 that moves it radially outward. Grease that contacts guide surfaces is hence
4 radially accelerated. Given the radial guide surfaces facing the spring chamber,
5 the grease on a guide surface will be transported radially outward along the
6 surface due to centrifugal force.

7

8 The second guide surface guarantees that grease splashing everywhere
9 cannot pass through the gap between the first guide surface and second module
10 since it is first captured by the second guide surface. Since the second guide
11 surface is situated faces the spring chamber in regard to the gap and hence in
12 regard to at least one area of the first guide surface, grease that leaves the
13 second guide surface radially outward is at least captured by the first guide
14 surface. The centrifugal force prevents this grease from accelerating radially
15 inward toward the gap between the first guide surface and second guide surface.

16

17 Because of the gap between the first guide surface and second module,
18 the spring chamber can be sealed without contact in the present invention. This
19 arrangement accordingly does not advantageously influence the other properties
20 of the torsional vibration damper, especially when it is used for clutches.

21

22 The first guide surface can be a baffle that is fixed to the first module.
23 Compared to the single-piece design of the first module and first guide surface,

1 this arrangement is easier to manufacture. In particular, difficult undercuts can be
2 avoided. Any type of suitable fastener can be used to connect the baffle and first
3 module such as soldering, welding, rivets, etc.

4

5 It is easier to manufacture a torsional vibration damper according to the
6 invention especially when the connection between the first module and the baffle
7 is a clip connection. For example, the baffle can be bent as a clamp that opens
8 easily due to the intrinsic elasticity of the material and grasps a projection of the
9 first module.

10

11 In particular, the baffle can be in the shape of a washer. Usually, a generic
12 torsional vibration damper has several tangential springs or spring chambers.
13 With such an annular arrangement, the annular design of the baffle is particularly
14 easy to mount since a corresponding baffle can be mounted in a single step for
15 all spring chambers. Given the radial symmetry of this design, it is easy to design
16 a clamp to connect the baffle with the first module.

17

18 In addition, the second guide surface can be designed as a guide disk.
19 Such a guide disk can be easily placed over the gap between the first guide
20 surface and second module on the spring chamber side. In particular, it is
21 advantageous for the cited reasons to design the guide disk serving as a second
22 guide surface in the shape of a washer.

23

1 The guide disk can be fixed to the first guide surface or the baffle. This
2 fixed connection can e.g. be created by a clip connection, a rivet connection or a
3 torx rivet connection. This fixed connection increases the stability of the unit
4 formed by the disk and first guide surface or baffle. In particular, it is possible to
5 create the guide disk out of a light and low-friction material such as plastic since
6 the first guide surface or baffle serves to stabilize the guide disk. This
7 arrangement also allows the guide disk and baffle to be premounted which
8 makes it easier to manufacture a torsional vibration damper according to the
9 invention.

10

11 There can be at least one opening facing the spring chamber between the
12 first guide surface and second guide surface. Lubricant or grease can be
13 returned to the spring chamber through this opening that has somehow reached
14 behind the second guide surface, e.g. by creep. In particular, it is advantageous
15 when the opening is situated so radially moving particles can pass through. In
16 this case, particles behind the second guide surface are returned to the spring
17 chamber.

18

19 There can be a calm space between the first and second guide surface
20 close to the gap between the first guide surface and second module. Lubricant
21 can collect in this area that has reached behind the second guide surface and is
22 thus prevented from passing through the gap. Such a calm space is particularly
23 advantageous when there is a corresponding opening in the radial exterior of the

1 area through which the collected grease can return to the spring chamber.

2

3 Between the first and second guide surface, there can be an element
4 (preferably a ring) made of absorbent material that covers the gap between the
5 first guide surface and the second module, at least when the torsional vibration
6 damper is still. Such an absorbent material can be any kind of material that can
7 absorb and release the lubricant, etc. in the spring chamber. In particular, this
8 material can be a felt-like sponge or foam. The material should have a greater
9 capillary force than the gap. When this absorbent material covers the gap
10 between the first guide surface and second module, grease, etc. is prevented
11 from creeping through the gap. When the torsional vibration damper rotates,
12 such creep is insignificant due to the centrifugal force. Hence this sealing ring
13 can be designed so that, upon rotation, it raises from the second module or first
14 guide surface due to centrifugal force to provide a contactless seal when the
15 torsional vibration damper rotates. In particular, this seal can be in a calm space
16 between the first and second guide surfaces.

17

18 In addition, it is advantageous when radial, external openings are provided
19 between the first guide surface and second guide surface to the spring chamber.
20 Lubricant collected in the sealing ring is transported by centrifugal force into the
21 spring chamber.

22

23 It is especially possible to premount an arrangement consisting of the

1 sealing ring, baffle and guide disk. For example, the baffle and guide disk can be
2 fixed together as described above so that the sealing ring is suitably fixed
3 between the guide disk and baffle.

4

5 The sealing ring can be held under radial, inward pretension of a guide
6 disk comprising one of the two guide surfaces. The guide disk can be designed
7 so that the pretension is preferably reduced to zero when the torsional vibration
8 damper rotates. The guide disk can e.g. have axial projections that grip the
9 sealing ring and press radially inward against the second module. The axial
10 projections are dimensioned so that they move outward under centrifugal force
11 when the torsional vibration damper rotates and hence release the sealing ring.

12

13 The second module of the torsional vibration damper according to the
14 invention can be a third, essentially radial guide surface that covers an axial gap
15 between the second guide surface and the second module on the side facing
16 away from the spring chamber. Lubricant particles that may pass through a
17 possibly existing axially-open gap between the second guide surface and the
18 second module can hence be captured by the third guide surface and be
19 transported radially outward on it. The gap between the first guide surface and
20 the second module is advantageously axially further from the spring chamber
21 than the third guide surface. If a particle transported on the third guide surface
22 reaches the radial outer end of the third guide surface and is released radially
23 from the end under centrifugal force, it cannot leave the spring chamber since the

1 actual opening of the spring chamber, i.e., the gap between the first guide
2 surface and second module is further removed in an axial direction from the
3 spring chamber.

4

5 To cause the lubricant or grease to return into the spring chamber, there
6 can be other guide surfaces in the spring chamber, especially close to the first
7 guide surface, and/or in a calm area between the first and second guide surface;
8 particles landing on the guide surfaces are accordingly deflected in a desirable
9 direction when the torsional vibration damper rotates, preferably toward the
10 spring chamber or the spring.

11

12 The torsional vibration damper can also have means to close the gap
13 between the first module and second module depending on the angle of rotation
14 between the first and second modules. These means can be designed so that
15 the spring chamber is completely closed when a specific angle of rotation is
16 attained between the two modules and the danger of splashed grease is the
17 greatest. When the angle of rotation is slight or zero, the gap can be left open to
18 provide a contactless seal of the spring chamber, at least at this site, and hence
19 a slight amount of friction.

20

21 The closing means can comprise at least one projection that is moved
22 axially upon a certain angle of rotation. The projection can be connected to a
23 door that bridges the gap between the first module and second module when the

1 projection moves axially. It is especially possible to also use an existing baffle as
2 a door.

3

4 Any component of the torsional vibration damper can be used as a drive
5 for the projection that causes the first module and second module to rotate in
6 relation to each other. In particular, these projections can be on the first or
7 second module. Particularly suitable are feather keys between which the springs
8 are located.

9

10 Of course, the cited closing means can be advantageously used to seal a
11 spring chamber independent of the cited features of the torsional vibration
12 damper.

13

14 In addition, the torsional vibration dampers can have a grease transport
15 system actuated by centrifugal force. The grease is sprayed in every direction in
16 the spring chamber during operation. Usually, however, the grease is only
17 required at certain areas in the spring chamber. When a grease transportation
18 system according to the invention is provided, the grease distributed in the spring
19 chamber can be returned to the desired positions.

20

21 The grease transport system advantageously has a grease collector that
22 is radially inward and a grease dispenser that is radially further out. Means are
23 provided between the grease dispenser and grease collector to move the grease

1 peripherally along its path from the grease dispenser to the grease collector.
2 While the grease automatically moves radially under centrifugal force, the moving
3 means according to the invention allow the grease to be intentionally transported
4 in a peripheral direction.

5

6 Any surface of the torsional vibration damper can serve as the grease
7 collector according to the invention. In particular, the grease can be collected
8 through gaps or openings, e.g. through a gap behind a guide surface.

9

10 The moving means according to the invention can e.g. be structures
11 formed on a surface with radial components such as deflectors that deflect
12 particles such as grease particles in a peripheral direction when they are moved
13 radially outward by centrifugal force.

14

15 Of course the described grease transport system can be advantageously
16 used independent of the other features in a torsional vibration damper in which
17 grease is only required at certain sites.

A 18 BRIEF DESCRIPTION OF THE DRAWING

19 Other advantages, properties and goals of the present invention are found
20 in the drawings to the following description in which are portrayed ten exemplary
21 embodiments of torsional vibration dampers according to the invention. The
22 drawing shows in:

23

1 FIG. 1 a section of a first embodiment of a torsional vibration
2 damper according to the invention;

3

4 FIG. 2 a cutaway view of FIG. 1;

5

6 FIG. 3 a section of a second embodiment of the torsional vibration
7 damper according to the invention at a projection in a first module;

8

9 FIG. 4 the torsional vibration damper of Fig. 3 in a representation
10 similar to FIG. 2;

11

12 FIG. 5 a third embodiment of a torsional vibration damper in a
13 representation similar to FIG. 2;

14

15 FIG. 6a a fourth embodiment of a torsional vibration damper in a
16 representation similar to FIG. 3;

17

18 FIG. 6b a torsional vibration damper of FIG. 6 in a representation
19 similar to FIG. 2;

20

21 FIG. 7a a variation of the forth torsional vibration damper in a
22 representation similar to FIG. 3;

23

1 FIG. 7b the variation from FIG. 7a in a representation similar to
2 FIG. 2;

3

4 FIG. 8a a section of another variation of the fourth torsional vibration
5 damper;

6

7 FIG. 8b the variation from FIG. 8a in a representation similar to
8 FIG. 1;

9

10 FIG. 8c the variation from FIG. 8a and 8b in a representation similar
11 to FIG. 2;

12

13 FIG. 9a a fifth embodiment of a torsional vibration damper according
14 to the invention in a representation similar to FIG. 1;

15

16 FIG. 9b the torsional vibration damper variation from FIG. 8 in a
17 representation similar to FIG. 2;

18

19 FIG. 10 a sixth embodiment of a torsional vibration damper
20 according to the invention in a representation similar to FIG. 3;

21

22 FIG. 11 the torsional vibration damper from FIG. 10 in a
23 representation similar to FIG. 2;

1 Fig. 12 a seventh embodiment of a torsional vibration damper
2 according to the invention in a representation similar to FIG. 2;

3

4 Fig. 13 an eighth embodiment of a torsional vibration damper
5 according to the invention in a representation similar to FIG. 2;

6

7 FIG. 14 the torsional vibration damper from FIG. 13 in another
8 operating position;

9

10 FIG. 15 a ninth embodiment of a torsional vibration damper
11 according to the invention in a representation similar to FIG. 2; and

12

13 FIG. 16 a tenth embodiment of a torsional vibration damper
14 according to the invention in a representation similar to FIG. 2.

A 15 DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

16 The first embodiment (FIG. 1 and 2) of the torsional vibration damper
17 according to the invention of has a first module 1 and a second module 2 that
18 rotate in relation to each other. The two modules 1 and 2 abut a spring
19 chamber 7 in which is located a spring arrangement 70. The spring
20 arrangement 70 acts tangentially between the two modules 1 and 2, and the first
21 module 1 has projections 72 that interact with feather keys 71 of the spring
22 arrangement 70.

23

1 Clipped onto the first module 1 is a disk-shaped baffle 3 (clip
2 connection 10) that has a first guide surface 30 and is at a distance from the
3 second module 2 across a gap 31.

4
5 In addition, the torsional vibration damper has a washer-shaped guide
6 disk 5 that is attached to the baffle 3. This guide disk 5 is at a distance from the
7 second module 2 across a gap 51 and has a second guide surface 50.

8
9 Behind the guide disk 5 or the second guide surface 50 is a calm area 40
10 that is partially filled by a sealing ring 4. The sealing ring 4 abuts the second
11 module 2 and covers the axial gap 31 between the first guide surface 30 and the
12 second module 2. In this exemplary embodiment, the sealing ring 4 consists of
13 felt.

14
15 On the exterior radial side of the calm area 40 are openings 6 between the
16 first guide surface 30 and the second guide surface 50 or between baffle 3 and
17 guide disk 5.

18
19 On the side of the gap 51 facing away from the spring chamber 7 between
20 the second module 2 and second guide surface 50 is a third guide surface 20.

21
22 Each of the three guide surfaces 30, 50 and 20 have an axial surface
23 component that faces the spring chamber. When the torsional vibration damper

1 rotates, particles on the guide surfaces 30, 50 and 20 move radially outward and
2 remain in the spring chamber 7. Particles that pass through the gap 51 are
3 conveyed on the third guide surface 20 into the calm area 40 and pass from
4 under centrifugal force with the particles in the sealing ring onto the first guide
5 surface 30 and through the opening 6 back into the spring chamber 7. Particles
6 on the second guide surface 50 are conveyed radially outward and reach the first
7 guide surface 30 by centrifugal force.

8

9 The sealing ring 4 is selected so that it raises from the second module
10 upon a desired speed of the torsional vibration damper. This provides a
11 contactless seal of the spring chamber 7 at this and higher speeds.

12

13 The second embodiment (FIG. 3 and 4) of the torsional vibration damper
14 essentially corresponds to the first embodiment. The second embodiment has an
15 essentially planar guide disk 5 that fits positively with the baffle 3 via several
16 recesses (connections 52).

17

18 Between the connecting sites 52 are radial, long recesses for the baffle 3
19 that form the openings 6.

20

21 The third embodiment (FIG. 5) has nearly the same design and differs

22 only in that a spot weld is provided at the connection site 52. Alternately, a lens-

23 shaped recess can be provided in the baffle 3 in which fits a corresponding

1 projection of the guide disk 5.

2

3 The fourth embodiment (FIG. 6a and 6b) also essentially correspond to
4 the second embodiment. However, there is no sealing ring. Instead, the second
5 module 2 has a concave guide surface 41 that extends from the gap 31 between
6 the second module 2 and the first guide surface 30 into the calm area 40, and an
7 extension contacts the third guide surface 20. When the torsional vibration
8 damper rotates, particles on the third guide surface 20 or the concave guide
9 surface 41 are transported to the extension to be conveyed radially into the calm
10 area 40 on the first guide surface after correspondingly overcoming the adhesion
11 force.

12

13 An angled deflection surface 61 is provided in a peripheral direction on
14 both sides of each opening 6 in this embodiment, and this prevents or reduces
15 the collection of grease in the calm area 40 on surfaces parallel to the rotational
16 axis. These deflection surfaces 61 have an axial surface component and deflect
17 grease in a peripheral direction.

18

19 A first variation of the fourth embodiment is shown in FIG. 7a and 7b.
20 While in the fourth embodiment the openings 6 are at the height of the
21 projections 72 of the first module 1, the openings 6 are at the height of the
22 springs 70 in this variation. Depending on the existing requirements, the grease
23 is accordingly transported to the desired location.

1 In this first variation, the guide disk 5 is planar and has an outer radius that
2 approximately corresponds to the outer radius of the baffle 3. The guide disk 5
3 can accordingly be attached together with the baffle 3 to the first module 1 by
4 clips 10, and it is particularly easy to mount this embodiment. In the guide disk 5
5 are holes 60 at the height of the radial outward side of the calm area 40 that form
6 the openings 6 through which grease is removed.

7
8 A second variation shown in 8a - 8c has an enlarged, annular calm
9 area 40 in contrast to the first variation.

10
11 In addition, three holes 60 are in the guide disk 5 at the height of the
12 spring arrangement 70 instead of the one hole 60 in the first variation. In this
13 second variation, deflection surfaces are not used, and the grease is merely
14 transported by a suitable arrangement of the holes 60. In this variation, the
15 grease displacement means comprise three holes 60 and the first guide
16 surface 30 (on which the grease collects until it is removed through the holes 60).

17
18 The fifth embodiment (FIG. 9a and 9b) of a torsional vibration damper
19 according to the invention also essentially corresponds to the cited embodiments.
20 There is a sealing ring 4 in this fifth embodiment, however.

21
22 In contrast to the fifth embodiment, there is no sealing ring in the sixth
23 embodiment (FIG. 10 and 11). In addition, the calm area 40 is not a continuous

1 ring but is rather divided into chambers. Between these chambers are bars to
2 which the baffle 3 and guide disk 5 are also connected. Holes 60 are used for
3 these connections that serve as openings 6 at the height of the calm area 40
4 between the baffle 3 and second guide surface 50. In this embodiment, the high
5 stability of the guide disk 5 is guaranteed so that a less stable material can be
6 used as the guide disk 5.

7

8 In the seventh embodiment (FIG. 12), the guide disk 5 is not connected to
9 the baffle 3 but is placed on the second module 2. The guide disk 5 rotates
10 together with the second module 2 in this embodiment. The opening 6 is formed
11 by an axial gap between the baffle 3 and guide disk 5.

12

13 The guide disk 5 is also on the second module 2 in the eighth embodiment
14 (FIG. 13 and 14), and is at a distance from the baffle 3 across opening 6. In this
15 embodiment, the baffle 3 has projections 32 that interact with feather keys 71 on
16 the ends of the springs 70 in such a manner that the projections 32 are moved by
17 a feather key 71 toward the second module 2 when the spring 70 is compressed,
18 i.e., the second module 2 is moved relative to the first module 1. As a result of
19 this movement, the baffle 3 is pressed against a seal 42 that is provided on the
20 second module 2. The spring chamber 7 is completely sealed when the spring 70
21 is compressed to avoid the danger of flying grease. When the spring is not
22 compressed or only compressed slightly, a contactless seal of the spring
23 chamber 7 is provided.

1 In the ninth and tenth embodiments (FIG. 15 and 16), the baffle 3 is
2 continuously pressed against the seal 42. The force necessary for this is
3 provided by fingers 53 of the guide disk 5. To ensure a stable seat of the guide
4 disk 5 despite the axial force, the guide disk 5 is attached with a clip 54 to the
5 second module 2. The baffle 3 hence glides continuously across the seal 42 in
6 the ninth and tenth embodiment. When modules 1 and 2 execute a relative
7 movement in relation to each other, the feather key 71 acts via the projection 32
8 on the baffle 3 and reinforces the sealing force of the baffle on the seal 42. The
9 ninth and tenth embodiments differ by the radial distances of the contact point of
10 the fingers 53 on the baffle 3. The resulting force, especially on the second
11 module 2, can accordingly be regulated. When the second module 2 is used as a
12 coupling flange of a clutch, the fingers 53 can be designed to cause the resulting
13 force to act in the direction of the actuating force of the clutch.